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Fusarium Wilt of Tomato and Its Control by Means of Resistant Varieties

BY

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Wilt is among the most serious diseases of the tomato in California, often inflicting considerable loss both on the shipping and on the canning crop. It is exceptional to find a field entirely free from wilt, and cases frequently occur where from 5 to 10 per cent, and occasionally as much as 85 per cent, of the crop is lost. The disease varies considerably in severity in different seasons. For instance, in the Santa Clara Valley it was more severe in 1922 than in 1923. As a rule, wilt is more important than Western blight in regions near the coast, such as Orange County and the San Fernando and Santa Clara valleys.

The cause of wilt is a fungus (*Fusarium Lycopersici* Sacc.) which inhabits the soil and invades the young roots of the tomato plants. The plants may become infected either in the seedbed or in the field after transplanting. The wilt fungus is rather widely scattered in the tomato growing sections of the state. Once present in any part of a field, it tends to spread, especially if the land is cropped to tomatoes at short intervals or, still worse, without rotation.

Very often wilt is referred to as "blight," in spite of the fact that the two diseases are quite distinct and are easily distinguished even when the same plant is attacked by both. In view of this confusion, a description of the characteristic symptoms of wilt is included here.

FUSARIUM WILT SYMPTOMS IN CALIFORNIA

Once the wilt fungus has gained entrance into the roots of the tomato plant, is grows up through the woody part of the vascular bundles into the stem, sometimes for a considerable distance. Corresponding to the growth of the fungus from below upwards, a yellow

discoloration of the lowest leaves occurs, usually giving the first indication of the disease. As the disease develops, the lower leaves turn brown and the upper leaves often appear unusually dark green, while the leaflets become curled downward and shrunken. If the progress of the disease is very rapid, some wilting of young leaves occurs, as the name of the disease indicates, but the wilted condition is by no means always present. In this stage the affected plants appear as if suffering from lack of water. A good indication of wilt is the browning of the woody tissues of the stems and roots, best seen by cutting or splitting the main stem near the ground. The discoloration usually does not extend into the pith or central part of the stem until the final decay sets in.

It is common with this disease to find that, while some of the stems of the tomato plant are diseased, the remainder appear quite healthy. One side of a stem may even show browning of the wood, while the other side appears healthy and free from discoloration. Diseased plants often put out new and healthy shoots; these however in turn may become infected. In the final stage of a serious case of wilt the plant turns brown, dries up, and dies. Those affected plants which continue to live through the season produce some fruit. The yield, however, is much reduced and the fruit undersized, although the seeds usually mature. If seedlings become infected while in the seedbed, they may perish early, or if transplanted to the field, are likely to die without producing any crop.

PREVENTIVE MEASURES

Since the infection occurs, as a rule, either in the seedbed or in the field, the greatest care should be taken to select land which is free from the wilt fungus. If the seedlings show any "damping off" or "collar rot," the seedbed should not be used another year. Plants from such a seedbed are likely to develop wilt. Even if no disease is observed, the repeated use of the same seedbed year after year is not a good practice. Infection with wilt in the seedbed (as with some other diseases) usually has far worse consequences than infection in the field. The practice of buying plants should, if possible, be avoided, as such plants are frequently the means of introducing some disease.

It is difficult to be sure that a field for tomatoes is entirely free from disease, and sometimes it is necessary to plant in a field in which some infection is present. Consequently, some means of control must be sought. Once the plants are set out, no control measures

Fig. 1.—Healthy tomato plant.

Fig. 2.—Tomato plant affected with Fusarium wilt. Branch to left wilted; to right dried up from disease. Healthy growth in center.

avail. Treatment of the soil before planting with fungicides such as formaldehyde is costly and not practicable except on a small area. Rotation of crops, however, is advisable as it affords some protection against wilt. If, for example, tomatoes are planted once in three years, the wilt disease will probably cause less damage than if tomatoes are planted more frequently. But it should be noted that the fungus is not solely dependent on tomato plants for its maintenance. It may live for one or more years on decayed organic matter in the soil, only to reappear when tomatoes are planted there again. Crops such as watermelons, peppers, and potatoes are not likely to be affected by the tomato wilt, although these crops may suffer from wilts caused by closely related fungi.

WILT RESISTANT VARIETIES

The best method of control is the use of wilt resistant varieties. This method is being successfully applied in many tomato growing states in which wilt has caused serious loss. Such varieties are not entirely proof against the disease. On the contrary, they become infected but are able to produce a satisfactory crop in spite of it.

At the present time, the variety most widely grown in southern California and in the San Joaquin Valley is Stone. This variety is very susceptible to wilt. San Jose Canner, a variety with large well-shaped fruits (not to be confused with the so-called "Jap Canner") is also very susceptible. The same is true of Earliana, a variety grown to a considerable extent for the local market. Probably these three varieties are used on more than half of the tomato acreage of the state, and none of them is resistant to wilt. They are in many respects well suited to the sections in which they are grown and often produce heavy crops, but being susceptible to wilt, they are not suitable for planting on wilt infected land. Indeed, such a practice may lead to serious loss as some recent experiments clearly indicate.

During the season of 1923 many tomato varieties reported to be wilt-resistant in other states were tested on plots situated at Riverside, La Mesa in San Diego County, and at Chatsworth in the San Fernando Valley. One variety named Norton which proved wilt resistant at all three places may be recommended for commercial planting in place of the Stone wherever wilt disease has been at all troublesome.

Norton originated as a selection from Stone and closely resembles the parent variety. The principal difference lies in the fact that Stone is very susceptible to wilt, whereas Norton is resistant. In

1923, in a field in San Diego County which was severely infected with wilt, the variety Stone was practically a total failure, but Norton, growing on the same field, gave a satisfactory crop. Even on land free from infection Norton gives results equal to Stone. For instance, in 1923, a large grower in the San Fernando Valley who planted some thirty acres of this variety in a field almost free from wilt infection, reports that Norton, although somewhat smaller in size, was at least equal to Stone in production and seemed to have somewhat heavier fruit. If the wilt disease had been prevalent in this field, as was often the case in 1923 in the San Fernando Valley, Norton would have given much the larger crop.

It should be noted that resistance to wilt by no means indicates any resistance to Root Knot (Nematode) or to Western blight. Although Norton is recommended for planting in sections where Stone is now grown, it may not be suitable for other sections, such as the Santa Clara Valley where the "Jap, Canner" variety is now largely grown. It is not yet possible to recommend a wilt resistant variety fully adapted to the conditions of the Santa Clara Valley or other northern coastal sections, but it is hoped in time to develop from the "Jap, Canner" a more wilt resistant selection.

Several other promising varieties showed wilt resistance in the recent trials in California. Among them is the well known Globe variety, which is earlier in maturing than Stone but later than Earliana. It has pink fruit of exceptionally good shape but considerably smaller in size than Stone. The foliage is rather scanty, thus making the fruit more subject to sunburn. Being earlier than Stone, wilt resistant, a good shipper, and prolific, Globe may be used to advantage under suitable conditions.

Certain other varieties have also shown indications of resistance to wilt disease but need further trial of their wilt resistance and other qualities before any of them can be recommended for planting. Some of the most promising may be mentioned here. Marvel appeared to be remarkably wilt resistant and produced a good crop on heavily infested land. It bears scarlet fruit of good shape but smaller than Stone although earlier in maturity. Louisiana Red and Louisiana Pink were also wilt resistant. These varieties produced good yields of early maturing fruit, that of Louisiana Pink being larger in size. As with other early varieties the vines were rather scanty. Norduke also seemed to be very resistant to wilt. This variety matured later and was not equal to Norton in production. It bears scarlet fruit equal to Stone in size and the vines are exceptionally luxuriant, thus affording ample shade for the fruit.

SUMMARY

Wilt disease of tomatoes, caused by the fungus *Fusarium Lycopersici* Sacc., inflicts serious losses on tomato fields in California. Soil of the tomato seedbeds should be free from the fungus, as infection in the seedbed is destructive to the young plants and is often the means of spreading the disease to uninfected fields. If the field is already infected, a rotation of crops is advisable. When an infected field is to be cropped to tomatoes, wilt resistant varieties should be used.

In sections where Stone is now the standard variety, Norton is recommended in preference, as it is resistant to wilt and is a desirable commercial variety. Globe has also shown wilt resistance and under suitable conditions may be useful where a somewhat earlier variety for shipping is desired.

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